

**Date:** September 16, 2009

**Title:** Capture-Recapture (section 2.2)

**Objective:** Become familiar with representative samples and understand the capture-recapture method.

**IN:** Find the value of the unknown number in each proportion:

$$\frac{24}{40} = \frac{X}{30}$$

$$\frac{220}{33} = \frac{60}{Y}$$

$$\frac{36}{15} = \frac{Z}{13}$$

**How good is your  
imagination?**



Brainard Lake, Colorado

How do wildlife biologists estimate the fish population in a lake?

In this investigation you will simulate the capture-recapture method and examine how it work.

Your objective is to estimate the total number of fish in the lake.

### **Vocabulary/Ideas for your interactive notebook**

*Sample:*

A portion, piece, or segment that is representative of a whole.

*Population:*

The set of individuals, items, or data from which a sample is taken. Also called universe.

*Capture-Recapture Method:*

Capture - tag - Release - then Capture another sample.

## **Vocabulary/ideas for your interactive notebook**

### *Representative:*

Exhibiting the qualities, traits, or characteristics that identify a group, category or population.

### *Population:*

The set of individuals, items, or data from which a sample is taken. Also called universe.

### *Prediction:*

The act of forecasting in advance.

## **Group Expectations:**

### Roles

1. Biologist #1 - person taking samples and counting fish
2. Biologist #2 - person counting tagged fish for release
3. Recorder - person documenting data
4. Analyst - person calculating ratio

Be respectful of your group members.

Everybody works together, takes notes & completes the table in their interactive note books.

You are high school students. No throwing or shooting "fish".

## **Investigation**

The paper bag represents the lake,  
the \_\_\_\_\_ beans are the untagged fish in the lake,  
and the \_\_\_\_\_ beans are the tagged fish returned  
to the lake.

Your objective is to **estimate** the total number of fish in  
the lake.

### **Investigation: Step 1**

- a. Reach into the lake and remove a handful of fish to tag.
- b. Count and record the number of fish you removed.
- c. Replace these fish (\_\_\_\_\_ beans) with an equal number of tagged fish (\_\_\_\_\_ beans).
- d. Return the tagged fish to the lake.
- e. Set aside the extra beans.

## Investigation: Step 2

- a. Allow the fish to mingle (seal the bag and shake it).
- b. Again remove a handful of fish, count them all, and count the number of tagged fish.
- c. In a table like this, record those counts and the ratio of tagged fish to total fish in the sample.

Sample Number	Number of Tagged Fish	Total Number of Fish in Sample	Ratio of Tagged Fish to Total Fish
1			
2			
3			
4			
5			

- d. In a table like this, record those counts and the ratio of tagged fish to total fish in the sample.

You have taken one sample by randomly capturing some of the fish. You could use this sample to estimate the number of fish in the lake, but by taking several samples, you will get a better idea of the ratio of tagged fish to total fish in the lake.

- e. Replace the fish, mix them, and repeat the sampling process four times, filling in a row of your table each time until you have five samples.

### **Investigation: Step 3 - 5**

3. Choose a representative ratio for the five ratios.  
Explain how you decided this was a representative ratio.

4. If you mixed the fish well, should the fraction of tagged fish in a sample be nearly the same as the fraction of tagged fish in the lake? Why or why not?

5. a. Write and solve a proportion to find the number of fish in the lake. (About how many beans are in your bag?)

b. Why is this method called capture-recapture?

### **Example A:**

#### **Finding an Unknown Percent**

In a capture-recapture process, 200 fish were tagged. From the recapture results, the game warden estimates that the lake contains 2500 fish.

What percent of the fish were tagged?

### **Example A: Solution to Finding an Unknown Percent**

You know that the ratio of tagged fish (the part) to total fish in the lake (the whole) is 200 to 2500.

$$\frac{p}{100} = \frac{200}{2500}$$

Write the proportion.

$$p = \frac{200}{2500} \cdot 100$$

Multiply by 100 to undo the division.

$$p = 8$$

Multiply and divide.

This ratio is equivalent to the percent  $p$  of tagged fish in the sample. In the samples used for the estimate, 8% of the fish were tagged.

### **Example B: Finding an Unknown Total**

In a lake with 250 tagged fish, recapture results show that 11% of the fish are tagged.

About how many fish are in the lake?

### **Example B: Solution to Finding an Unknown Total**

You can write 11% as the ratio or 11 parts to 100 (the whole). The variable will be the denominator because the unknown quantity is the whole—the total number of fish in the lake.

$$\frac{11}{100} = \frac{250}{f}$$

Write the proportion.

$$\frac{100}{11} = \frac{f}{250}$$

Invert both ratios.

$$250 \cdot \frac{100}{11} = f$$

Multiply by 250 to undo the division.

$$2273 \approx f$$

Multiply and divide.

There are about 2270 fish in the lake.

### **Example C: Finding an Unknown Part**

A lake is estimated to have 5000 fish after recapture experiments that showed 3% of the fish were tagged.

How many fish were originally tagged?



### **Example C: Solution to Finding an Unknown Part**

You can write 3% as the ratio or 3 parts to 100 (the whole). The variable is in the numerator because the unknown quantity is the number of tagged fish (the part).

$$\frac{t}{5000} = \frac{3}{100}$$

Write the proportion.

$$t = \frac{3}{100} \cdot 5000$$

Undo the division.

$$t = 150$$

Multiply and divide.

About 150 fish were tagged.

### **Summary:**

**Write at least one paragraph for each question below:**

What is important about taking a sample? Why are samples useful?

How accurate are estimates using the capture-recapture method? Why?

In what other situations could the capture-recapture method be used? Why?



Homework: Page 106  
# 1 - 5

**Out:** You have written your name on 200 students' foreheads with a large purple marker before school. During passing period, you see that 15% of the students have your name on their forehead. About how many students are in the school?

**Turn in your Interactive Note Book**

**Have a Great Day!!!**